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ARMY AVIATION TEST BOARD FORT RUCKER ALA
ENGINEERING DESIGN TEST OF ELECTROLUMINESCENT PANELS AND ROTOR --ETC(U)
JUL 69 P W JONES

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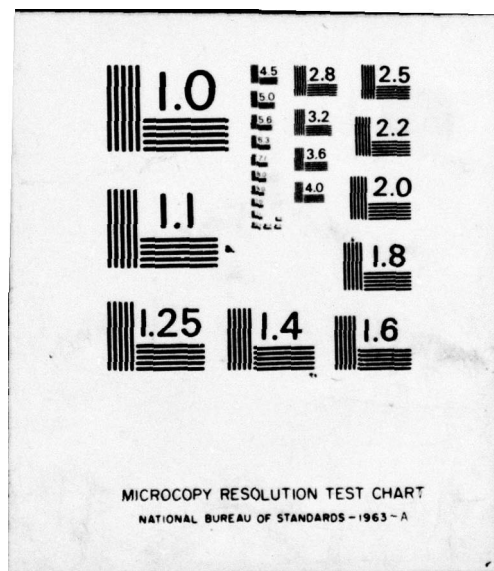
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DEPARTMENT OF THE ARMY
UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36360

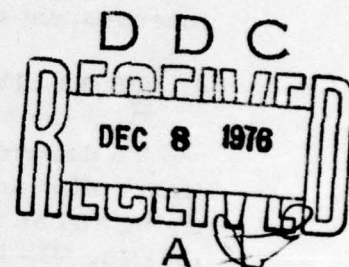
STEBG-TD-V

SUBJECT: Final Report of Support of Engineering Design Test of
Electroluminescent Panels and Rotor Tip Lights.
USATECOM Project No. 4-9-5002-01

⑩ Pat W. Jones

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⑨ Final rept. Apr-Jun 69,



1. REFERENCE

Letter, AMSEL-RD-GTT, Headquarters, US Army Electronics Command, 20 February 1969, subject: "Request for Category II test of Night Vision Device for Formation Flight," with first indorsement, AMSTE-BG, Headquarters, USATECOM, 16 April 1969.

2. BACKGROUND

In March 1968, US Army Materiel Command initiated a program to provide equipment to permit helicopter formation flight during hours of darkness. The concept ranged from relatively simple lights and electroluminescent panels with rotor tip lights to complex night vision devices. The initial phase of the program consisted of procuring equipment and subjecting it to engineering design (ED) test. On 16 April 1969, US Army Test and Evaluation Command directed the US Army Aviation Test Board to support US Army Electronics Command with this ED test.

3. DESCRIPTION OF MATERIEL

The night vision devices for formation flight consist of eight electroluminescent (EL) panels mounted on a UH-1() helicopter (as shown in inclosure 1), rotor tip lights, and two control units--one located on the upper pedestal and one on the lower console. The panels are 2 inches

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by 10 inches, with a louvered overlay to prevent detection below -5° and above $+10^{\circ}$ from the horizontal axis of the aircraft. The rotor tip lights are 1 inch by 2 inches by 1/2 inch and are located above the rotor tip tiedown on each blade end. Each tip light consists of five incandescent bulbs.

4. OBJECTIVES were

↳ To determine whether the electroluminescent panels and rotor tip lights offer an improved visual reference during night VFR formation flying and an increase in operational capability over the currently existing UH-1 night formation lighting system.

5. SCOPE AND METHOD

a. The USAAVNTBD provided support of this ED test in the vicinity of Fort Rucker, Alabama, during April-June 1969. The EL panels and rotor tip lights were installed on a UH-1C Helicopter and tested for 35 flight hours using a follower aircraft in formation in total dark night operations.

b. Nineteen aviators flew night formation without the use of radios. Eleven flights were in left echelon and eight were in trail. The following light configurations were used:

- (1) Navigation/position lights.
- (2) Navigation/position and rotor tip lights.
- (3) EL panels (minimum).
- (4) EL panels (minimum) and rotor tip lights.
- (5) EL panels (maximum).
- (6) EL panels (maximum) and rotor tip lights.

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6. RESULTS

a. All the pilots that flew formation stated that the EL panels with rotor tip lights were an improvement over the present formation lights. They were easier to follow and less tiring to the eyes, and pilots could maintain position with greater confidence.

b. It was determined that the rotor tip lights were the best single light configuration and gave the most information quickest to the follower. (See inclosures 2 and 3.) When the pilot made the slightest degree of bank, acceleration, or deceleration, the rotor tip lights indicated the change prior to movement of the airframe. These lights were helpful in marginal weather and when performing formation Ground-Controlled Approaches.

c. Panels No. 1 and 2 (inclosure 1), when aligned with each other, indicated to the follower pilot a definite angle (42°) to help him maintain position in echelon formation; however, at this angle, the follower pilot had to look around the door post to see the panels. Panel No. 4 was a green "L" incorporating No. 5 as a red triangle and the space between these two lights was a solid black line. This combination helped to determine 200-foot ranges when two distinct lights were seen by the average pilot. The two panels converged into one orange light at a distance greater than 200 feet. The tail-rotor drive-shaft light (No. 6) helped as a cross reference in trail formation in that when the pilot could see the panel, he knew instantly that he was not in the proper position. It offered no significant use for echelon formation.

d. The louvered overlay was not satisfactory for combat operations. All the EL panels could be seen from the ground at a lateral distance of 250 feet with the aircraft in straight and level flight at altitudes up to 1,500 feet, and at greater distances with the aircraft in a turn. The front door panel (No. 3) and upper tail-rotor panel (No. 8) were visible from the ground at a lateral distance of 3,400 feet with the aircraft at an altitude of 1,000 feet. The main-rotor tip lights could be seen from the ground when the aircraft was at 100 feet altitude, especially if any banks or decelerations were made.

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e. Landings were made without difficulty; however, the panels did not provide a reflection to determine proximity to the ground. As a result, the pilot of the lead aircraft had to use either the landing light or a fixed light on the ground when making approaches.

7. DISCUSSION

a. The rotor tip lights formed a "halo" that could be seen from above or below. A shielded light, that could be seen only from above, mounted on the main-rotor head would provide vertical position data to the follower pilot. When the "halo" and rotor head light were seen, it would indicate that the follower helicopter was above the lead helicopter. When the "halo" without the rotor head light is seen, it would indicate that the follower helicopter was below the lead helicopter.

b. This test was conducted using only one helicopter equipped with EL panels and rotor tip lights. Data are not available for formation flying with more than one helicopter equipped with these night vision devices. Prior to further USATECOM testing, EDT should include night formation flights of three or more helicopters equipped with EL panels and rotor tip lights.

8. CONCLUSIONS

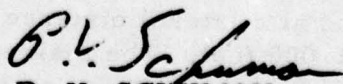
a. The electroluminescent panels and rotor tip lights offer an improved visual reference during night VFR formation flight.

b. The panels and lights increase operational capability over that afforded by the current UH-1 night formation lighting system.

FOR THE PRESIDENT:

5 Incl

1. Lighting Diagram
2. Comment Summary
3. Comment Summary
4. Support List
5. DD Form 1473


P. V. SCHUMAN
Captain, AGC
Adjutant

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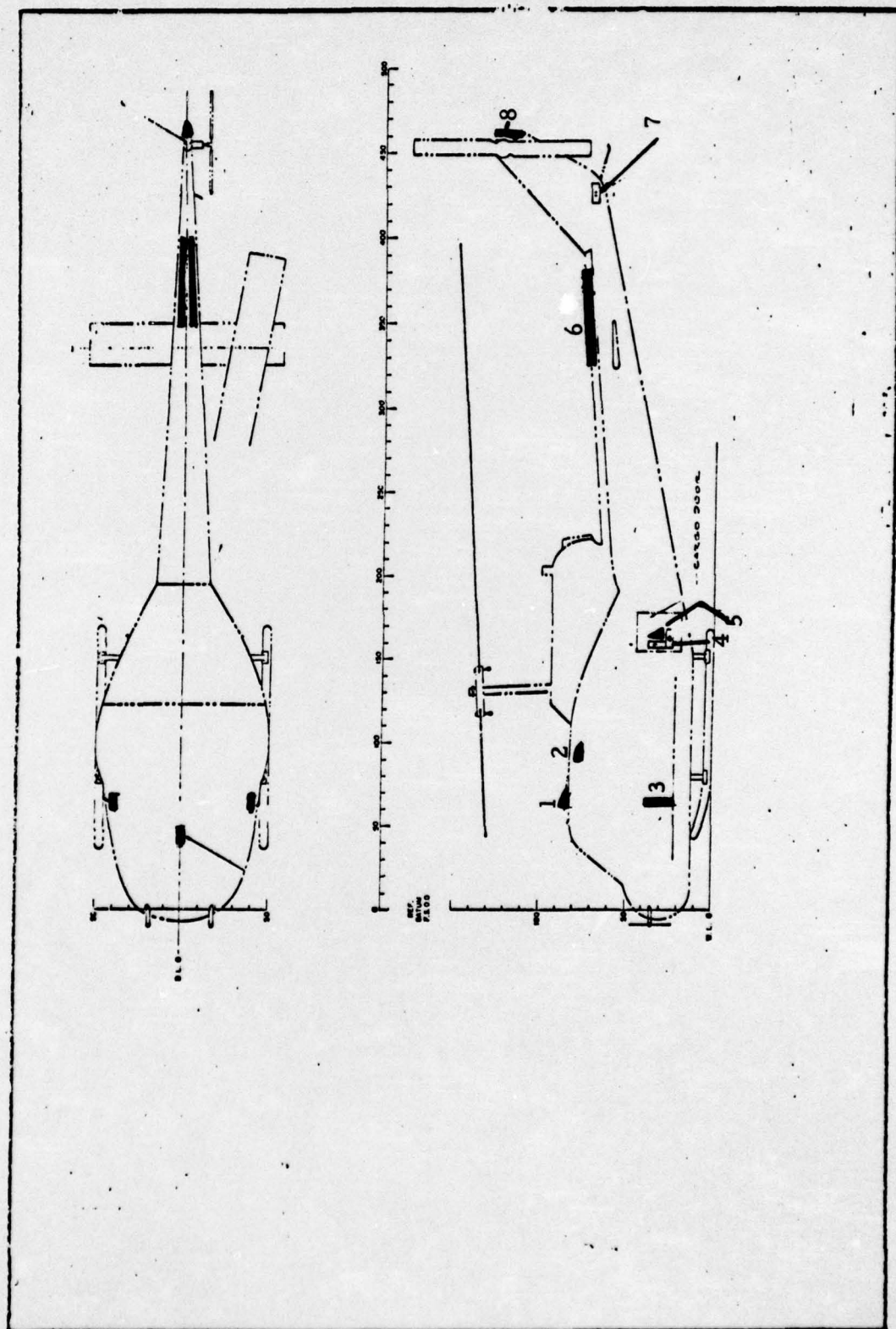
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INCLOSURE 1

ECHELON FORMATION

For each type of maneuver or operation listed, the box or boxes across the row were checked to indicate the combination of lights which gave the best information to the follower. In some instances the pilot indicated several configurations as being adequate.

	POSITION / NAVIGATION				EL PANELS						Lower Tail Panel
	Red & Green Side Lights	White Cabin Lights	White Tail Lights	Rotor Tip Lights	Amber & Green Top Panels	Front Green Door Panel	Green L	Red Triangle	Tail Rotor Drive Shaft Cover Panel	Top Tail Panels	
1. Right Turn		2	1	11	8		4	4	3	2	1
2. Left Turn		2	1	11	8		4	4	3	2	2
3. Ascent		1	1	11	9		5	5	2	2	1
4. Descent		1	1	11	8		5	5	2	3	1
5. Landing				7	6		5	5	2	1	
6. Take Off		1	1	5	4		1	1	2		1
7. Distance Estimation											
a. 200 ft.	1	1	2	9	2	1	9	9	2	1	
b. 500 ft.	1	1	3	9	1	1	3	3	1	1	
c. 1000 ft.	1	1	2	9	1	1	4	4	1	1	
8. Rendervous	1	1	1	9	6	1	8	8	4	3	2
9. Straight & Level		1		8	9	2	9	9	4	2	2

TRAIL FORMATION

For each type of maneuver or operation listed, the box or boxes across the row were checked to indicate the combination of lights which gave the best information to the follower. In some instances the pilot indicated several configurations as being adequate.

	POSITION / NAVIGATION			Rotor Tip Lights	EL PANELS					Top Tail Panels	Lower Tail Panel
	Red & Green Side Lights	White Cabin Lights	White Tail Lights		Amber & Green Top Panels	Front Green Door Panel	Green L	Red Triangle	Tail Rotor Drive Shaft Cover Panel		
1. Right Turn		2	1	7	6		5	5	4	4	1
2. Left Turn		2	1	7	6		5	4	4	4	1
3. Ascent		1	1	7	3		6	5	3	4	
4. Descent				7	3		5	4	3	4	
5. Landing		1	1	5	2	1	5	4	3	3	1
6. Take Off			1	3	2		3	2	2	1	
7. Distance Estimation											
a. 200 ft.		1		6	2	1	6	5	3	4	2
b. 500 ft.		1		6	3	1	4	3	3	4	2
c. 1000 ft.		1		6	3	1	3	2	3	4	2
8. Rendezvous	1			5	5	1	4	3	3	3	
9. Straight & Level		2	1	6	6	1	6	5	5	4	2

SUPPORT LIST

The following support was provided during the test:

1. Nineteen subject aviators.
2. Thirty-eight safety aviators.
3. Thirty-five flying hours.
4. Cost of parts installed on subject aircraft 28 April - 10 June 1969:
\$2,464.34.
5. Man-hours expended to maintain the aircraft: 150 (\$453).
6. Man-hours expended to pick up parts at other installations: 8 (\$41.52).
7. Fuel used for aircraft to pick up parts at other installations: 330
gallons (\$38.61).
8. Fuel used for test aircraft: 2,150 gallons (\$251.55).

INCLOSURE 4

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) US Army Aviation Test Board Fort Rucker, Alabama 36360		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE ENGINEERING DESIGN TEST OF ELECTROLUMINESCENT PANELS AND ROTOR TIP LIGHTS			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final Report of Support, April - June 1969			
5. AUTHOR(S) (Last name, first name, initial) JONES, PAT W., CW3			
6. REPORT DATE July 1969	7a. TOTAL NO. OF PAGES 9	7b. NO. OF REFS 1	
8a. CONTRACT OR GRANT NO. b. PROJECT NO. USATECOM Project No. 4-9-5002-01 c. d.		9a. ORIGINATOR'S REPORT NUMBER(S) 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) Firing Code: 0	
10. AVAILABILITY/LIMITATION NOTICES RESTRICTED US Army Electronics Command			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY US Army Electronics Command Fort Monmouth, New Jersey 07703	
13. ABSTRACT The US Army Aviation Test Board provided support to US Army Electronics Command in conducting the engineering design test of electroluminescent panels and rotor tip lights. The test was conducted to determine whether the panels and lights offer an improved visual reference during night VFR formation flying and an increase in operational capability over the currently existing UH-1 night formation lighting system. The panels and lights were installed on a UH-1C Helicopter and tested in the vicinity of Fort Rucker, Alabama, during April - June 1969. Several lighting configurations were used in both trail and echelon formations. The test items were an improvement over the present formation lights. The rotor tip lights were the best single light configuration, providing the most information to the follower pilot. Both the panels and the rotor tip lights were visible from the ground at varying distances, depending on the lighting configuration and the attitude and altitude of the helicopter. It was concluded that the electroluminescent panels and rotor tip lights offer an improved visual reference during night VFR formation flight and that the panels and lights increase operational capability over that afforded by the current UH-1 night formation lighting system.			

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ENCLOSURE 5

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Engineering Design Test						
Electroluminescent Panels						
Rotor Tip Lights						
UH-1C Helicopter						
Night Formation Flight						

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